DATA PROCESSING DIGEST

A SERVICE OF CANNING SISSON AND ASSOCIATES

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General Information

"Some aspects of reliability in electronic data processors,"
by William B. Elmore, Price Waterhouse & Co., New York
AMA CONFERENCE REPORT, February 1955.

"Reliability" includes at least two aspects: 1) freedom of the machine from breakdown due to component failure, and 2) freedom of the machine's output data from error. The second, called *accuracy*, is dealt with in this paper.

"No machine is completely infallible...[We can look] at the accuracy of electronic processors from two quite different view points. First, how accurate are they from an engineering standpoint (dependability)? Secondly, how adequately can these machines check their own results (self-checking ability)?"

Computational Dependability: "An electronic computer today can operate many hours--many days even--without any error...The performance of various physical components, such as vacuum tubes, has a fundamental effect on operating reliability and, consequently, on accuracy. Some interesting statistics have been gathered at M.I.T. on vacuum tube reliability. [For example, experiments revealed] an average tube life of 800,000 hours or about 400 years of forty-hour weeks...based on actual experience."

Dependability of Magnetic Tape Recording: "It seems safe to say that the most crucial link in the chain as far as electronic processors are concerned is in reading from and recording on tape...There is but little experience to draw upon in jobs that involve massive records maintained on magnetic tape. Among the data...are some results of IBM's laboratory research on their own 702 tape units. The 702 uses two so-called 'parity' checks on tape...The results of tests showed that the frequency of errors detected by the parity checks is about one error per 500,000 characters...97% of the errors detected were eliminated by simply rereading the tape...If we ignore those errors eliminated by rereading...we arrive at a figure of about one error per 22 forty-hour weeks... Such reliability in tape reading and recording is, of course, dependent upon the use of perfectly good tape with no defects in the magnetic coating...The progress in the achieving of such flawless tape is itself quite remarkable."

"IBM tapes have been stored for three years and read back without error. From one original recording 6000 successive readings have been made without any loss of signal strength and the test readings are still underway...The Univac uses a metal base tape rather than the plastic base tape used by IBM...both types of tape are quite suitable at present." In a fire test on Univac, six reels were placed in a safe, and the temperature in the safe raised to 550 degrees Fahrenheit...They were [then] read on a Uniservo without error."

"In regard to dependability...no degree of equipment dependability can correct human errors made in the transcription of raw data to punched cards, paper tape, magnetic tape or any other machine-readable medium."

Built-in Self-checking: "This ability is of two sorts--the so-called built-in checks and the programmed checks...The engineers tell us that they can give us all the built-in reliability we are willing to pay for. But...there is some point...beyond which further built-in checks are so unnecessary as to be essentially worthless.

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"...the Univac has probably the largest percentage of its circuits devoted exclusively to built-in checking operations. All arithmetic and logical operations are done twice in the Univac by different circuits, and the two results are automatically compared for equality...the users of the Univac at New York University report that in a year and a half of operation, there has been only one instance of undetected errors, and that arose because of a radical breakdown which could not possibly have been overlooked by the operator.

"The parity check...is a self-checking device... Most machines designed to handle alphabetic as well as numeric data employ a six-bit information code. The use of a seventh bit for this parity check...can be had for very little additional expense of design effort or equipment. And though it is a very simple check it is also an extremely powerful one...it is a check for those errors which are most difficult to detect...errors which result from the operation of a marginal vacuum tube, for example."

Other built-in checking devices: "Recording currents in the magnetic tape heads can be tapped and sent back to the central unit for a parity check or for comparison with the data in the memory which is being recorded. The inverse of each arithmetic operation can be carried out automatically and inverse result compared with the original factor for equality. In a machine using a fixed tape record length, a count of the number of characters read from a tape record or block can be made to insure that all characters have been read. Coded instructions can be examined for 'forbidden' codes. The entire memory can be periodically parity checked."

Programmed Self-checking: "Programmed checks can be as exhaustive as desired." Some examples of programmed checks: "Batch totals can be accumulated and checked to insure accuracy of reading input data. A count of the number of records and the totals of certain values within each record for a reel of tape can be stored on the tape and checked at each reading of that reel. And, of course, adequate accounting controls can and should be maintained."

Conclusions: "...the modern electronic data processor is by far...the most reliable method of machine calculation yet devised by man. The only area which seems at all questionable is the use of invisible recordings on magnetic tape as the medium for storage of vitally important records which are frequently reproduced in their entirety in the process of updating a file. And that area is questionable perhaps only for the present.. In the unlikely event that the parity check should prove inadequate for tape...duplicate recording on tape can be employed for checking. The National Cash Register CRC 102D already has this feature."

"Electronics - a company program," *by Joseph Pelej, Price Waterhouse & Co., New York*
AMA CONFERENCE REPORT, February 1955.

In planning a company program of electronic investigation, the following course of action is recommended:

"The development of a practical program of study which does not commit a company to a large expenditure of money unless, or until, the investigation of electronics in relation to the company's *own particular problems* indicates that an electronic installation will be beneficial to the *particular* company." That is, "the study of the application of electronics should be undertaken in relation to definite problems existing in the individual company."

Another factor to take into consideration is the number of exceptions to the established routines, and the ability to predict the nature of the exceptions, so that they can be incorporated in the electronic system. Also, consideration must be given to whether or not cheaper or better work in certain areas will result in more effective over-all operation.

To investigate these possibilities it is recommended that a study group be selected whose members have the following qualifications:

1- They should understand the concepts which guide management in the operation of the company.

2- They should have skill in systems.

3- They should have a sound knowledge of the operation and application of accounting and bookkeeping machines.

4- They should be familiar with the essentials of programming.

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5- They should have a knowledge of legal and audit requirements, and of fundamentals and application of internal control.

6- They should be skilled in evaluation of clerical costs and have sound judgment in making recommendations based on their studies.

7- They need analytical ability and imagination.

8- A knowledge of fundamentals of mathematics is of value.

Their method of investigation would be:

1- Visit machine manufacturers and attend their instruction courses.

2- Get information and ideas from others who have conducted studies.

3- Visit other electronic installations.

4- Select the area of operation to be studied. Either of two approaches is possible: the "blue sky" approach which is concerned with the development of information previously unobtainable because of cost, speed or other considerations; the "brute force" approach which is concerned with economy through reductions in clerical costs. The second approach is usually more sure of management acceptance since the economies and advantages are more readily demonstrated at once.

5- Acquaint those to be affected by the study with its aims and purposes to ensure co-operation. This would take the form of a course of instruction for management and others affected by the proposed system.

(It is suggested at this point, that the study, even if it shows electronics to be not feasible, will help clarify and probably improve the present system.)

6- Give careful consideration to all of the factors under which the equipment must be operated (e.g. consider frequency of interruption necessary to obtain information).

7- Determine the best equipment for the required tasks.

8- Summarize decisions and submit recommendations to management.

The next phase of the plan has to do with preparing for the use of the equipment: a detailed analysis of procedures and preparation of programs.

The investigation described above has the following accomplishments:

1- Decision on whether or not to acquire electronic equipment, and which to select.

2- Establishment of sound basis for acquiring equipment without fear of obsoletion.

3- Clarification of company's policy on electronics.

4- Better understanding by management of organizational changes necessary if electronic equipment is acquired.

5- Sound basis for future equipment planning.

6- Improvement of existing procedures.

7- Stimulation of broad thinking and creative ideas by the group.

8- Obtaining of clear view of principles of electronic applications by management, with reference to its own company.

9- Development of a group which can take on the programming and installation of the electronic system when the time comes.

"Consolidated Edison and electronics," *by F. J. Porter, Jr.*
Consolidated Edison Company, New York.
AMA CONFERENCE REPORT, February 1955.

Consolidated Edison began a program of investigation into the use of electronic computers in 1953. They believed they had two of the major requirements considered essential for the profitable adaptation of electronic data processing techniques--volume and centralized operations.

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During 1953 they began "an informal discussion group within the accounting sphere" consisting of two vice presidents, controller, general commercial manager, and several associated executives. In November, 1953, two of the group were enrolled in a two-week Remington Rand introductory computer course.

The following January the staff operation was started with three persons each from the controller's and the commercial relations group. These six were enrolled in Remington Rand's six weeks course in programming. At the same time three more from each group were selected "to start the logical analysis of our procedures in order that there might be some data ready for the programmers when they completed training."

Con Edison will follow the same procedure with IBM's 702.

The controller's staff has followed the pattern of analyzing a single function (Payroll) in great detail, with the objective of programming for an electronic data processing system.* The commercial relations staff has followed a different pattern. They have discovered their group breaks logically into three groupings: the programming group, which will actually program and code the system for the computer; the systems design group, which will develop a workable system, specify the computer runs needed, and design the necessary forms; and the clerical and control group, which will devise the control features, schedule the operation, and handle clerical work and file maintenance.

*See: "Problems of applying electronics to general accounting in a public utility," below.

"Problems of applying electronics to general accounting in a public utility,"

by J. W. Balet, Consolidated Edison, New York.

AMA CONFERENCE REPORT, February 1955.

The controller's staff at Con Edison chose the function of weekly payroll to do preliminary preparation for an electronic data processing system, since this area was already highly mechanized through the use of punched card equipment. The group hopes that "the weekly payroll may provide an economic payload for a large automatic computer. If this is not so, other general accounting procedures will be added until a break-even point [measured against the cost of present punched card procedures] is reached.

It was found that "a computer probably cannot be justified merely as a direct substitute for punched card equipment... clerical operations have to be analyzed even more rigorously than the machine operations."

The logical analysis of the weekly payroll is being made in two steps: first, a straightforward procedural analysis; and second, a simplification of the procedures.

"Decentralized management not threatened by data processors, AMA told"

OFFICE MANAGEMENT, May 1955; pages 26-29, 34-41

This report, which began in April issue of OFFICE MANAGEMENT, gives a brief summary of the AMA Conference on electronics, held in New York February 28-March 2, 1955. Conference papers also reviewed in DPD in May, June, and July issues.

"Tools of the office--accounting and bookkeeping machines and systems"

OFFICE MANAGEMENT, June 1955; pages 47-56.

While it is well known there are machines to handle most accounting and bookkeeping problems, the force which is really significant in the contemporary office is the growing consciousness of systems and their importance. Systems must often be company-wide in scope--or "integrated" with other company operations once thought to be completely separate. The heart of integrated data processing is the automatic perpetuation of repetitive information. Even conventional machines can be adapted to more efficient systems, and most modern machines are designed so that more than one record can be prepared at the same writing. The efficiency of a single department depends not solely on the internal workings of that department, but upon policies and systems that can extend throughout an entire company.

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((The article continues with a list of 25 equipment manufacturers and descriptions of their new office devices which produce written or printed records other than a simple record of computation.))

"How we planned for use of electronic equipment,"

by John S. White, Esso Standard Oil Co., Baton Rouge, La.

N.A.C.A. BULLETIN, June 1955; pages 1343-1347.

With management's enthusiastic co-operation, the Accounting Department at the Baton Rouge Refinery embarked on a program of installing electronic data processing equipment. Management suggested a broad liberal plan of education and training of personnel who would be either directly connected with the system, or supplying or using the system's data. It was felt that "it is important to give each department affected some orientation in electronic data processing machine technique and get co-operative acceptance of the program."

"Can control devices solve common problems facing industry and business?"

AUTOMATIC CONTROL, May 1955; pages 14-17.

Lane Bryant's mail order division in Indianapolis has recognized its need for automatic methods in its operation. Its general manager and methods engineer believe that the control industry should be creating smaller devices (than the large computing equipment now being made) designed to perform specific functions at somewhat slower speeds, and designed to be compatible with each other and with other equipment to meet the needs of an expanding operation.

Applications

"Automation in the office"

OFFICE MANAGEMENT, May 1955; pages 32, 33, 42, 44.

The B. F. Goodrich inventory system is described by Teleregister Corporation as being similar in principle to its Magnetronic Reservisors used by some of the airlines for handling reservations.

The new system at Goodrich will produce on demand a description of the difference between quantities on hand and committed orders. It will also create permanent records of individual transactions which can be used to prepare punched card summaries for accounting or forecasting.

Two basic input devices are used--a keyset similar to a small adding machine, and a Flexowriter. The keyset is used by the warehouse to introduce data on inventory additions. The Flexowriter will record data on orders received. If the amount to be subtracted from an inventoried item by a new order results in exhaustion of the inventory, the system will stop functioning and a warning light designating the particular item which has been exhausted will signal the shortage.

The new Univac II which has been introduced by Remington Rand doubles the speed and capacity of the current Univac. The Univac II has a magnetic core memory capable of retaining 24,000 characters. Additional memories may be added to increase capacity to 120,000. Tape units which operate with the Univac II are operated at more than twice the effective speed of present units. The new machine can be incorporated into existing installations built around the current Univac. ((See also JOURNAL OF MACHINE ACCOUNTING, June 1955, pg. 24, 25.))

Sylvania Electronic Products Co. and Western Union Telegraph Co. are working on a nationwide 12,000 mile private electronic communications system to link Sylvania plants, laboratories, sales offices, warehouses, divisional headquarters and executive offices in 57 cities with the new data processing center at Camillus, N. Y. Financial and production information will be fed over the leased network to the computing center, where it will be processed and summarized for both corporate and decentralized management.

"Some current thoughts on the possible use of magnetic tape policy files in a life insurance office,"

by M. E. Davis, Metropolitan Life Insurance Company, New York.

AMA CONFERENCE REPORT, February 1955.

Magnetic tape can be used in either of two ways in electronic data processing systems: 1) basic records can be in punched cards, converting to tape for processing; 2) basic records can be kept on tape from start.

Arguments against the second system are:

1- More experience with tape is needed.

2- Being an invisible record, it may take longer to get information out.

3- There are some technical limitations in tape.

4- Error exposure is high because changes require rewriting of entire reel.

5- Tape has not yet been fully accepted as valid record by business community at large.

6- Unless economy results, transferring records to tape will complicate unnecessarily the establishing of new automatic procedure.

There are two methods of introducing changes into magnetic tape file records:

1- Storing up changes on punch cards or a change file

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tape, then devoting a specific period to inserting all changes on records.

2- Random search provisions in the computer so that any record can be changed as the change is called for. This should be used sparingly to keep the computer from interfering with its other work. Only where rapid service is essential should this kind of record changing be done.

The Metropolitan Life Insurance Company experimented with various types of magnetic tape file systems, and found that daily updating of files is uneconomical where changes are to be made in scattered records, since the computer must search the entire tape to find the area in which the change occurs. However, where there are sufficient changes throughout to utilize the computer's searching through the entire tape, magnetic tape record keeping may be effective.

"Programming for Electronics," *by W. E. Eggleston, Commonwealth Edison Co., Chicago.*
AMA CONFERENCE REPORT, February 1955.

"Programming" to Commonwealth means the organization of work up to and including flow charts. Commonwealth started investigations into the possibilities of computers in 1949. In 1953 they chose customer billing and accounting, collection, and customer service areas in which to begin their electronic system. They ordered an IBM 702 and since ordering have begun working on the applications. They have, at present, a staff of 25. Instructors were given only two or three students each, so that more thorough training was possible, and training time was on a flexible schedule, so that as much time could be used for training as was needed.

In the new system the basic record will be magnetic tape (formerly punched cards). The central tape record will include information on unpaid charges, and a year's use history of each account for handling delinquent accounts. To aid in obtaining continuous visual records for human reference, three kinds of listings will be printed out:

1- A bill register, including all of the data currently on magnetic tape.

2- Semi-monthly, details of open accounts, money entries and other record changes.

3- Daily, cumulative type list of unposted money entries.

Since the lists do not have to be fed back into the machine, as with cards, the record-keeping function can be decentralized. Division offices will have customer account information without having to do bookkeeping.

Mark sense meter reading, punched cards to operate bill printing machines, and punched bill stubs have been carried over from the old system.

New features include:

1- Mechanical check over six months to determine whether or not to issue bill. Adjustment for obvious meter reading errors.

2- Collection notices issued at time wanted.

3- Charge off of uncollectible accounts automatically on a formula basis.

4- Scheduled main tape file look-ups for information in addition to semi-monthly processing.

5- Mailing of regular bills on day following meter reading.

6- Internal balancing as part of every computer operation.

PROGRAMMING

"Compiling routines," *by Grace M. Hopper, Remington-Rand, Philadelphia.*
AMA CONFERENCE REPORT, February 1955.

Additional orders in a computer, without adding hardware, can be provided by the technique of programming their equivalent and recording them in the memory of the computer for reference. (Reprinted from COMPUTERS AND AUTOMATION, May 1953.)

((See definition of "compilers" in Comment section.))

Equipment

"IBM develops new 'random access' memory unit"

OFFICE MANAGEMENT, June 1955; pages 38, 62, 64.

The IBM 305 is a "random access" memory device which can store five million characters. It can be used with both punched card and magnetic tape operated machines. The unit is composed of a stack of magnetic discs, mounted on a vertical shaft, and slightly separated from each other. Data is stored in the form of magnetized spots on the discs. A "reading and writing arm" at one side of the stack moves under electronic control directly to the point on the disc carrying the desired information. Systems using the new device will be able to process business transactions as they occur, item by item, keeping all records up-to-the-minute and immediately available to management.

As an example for its use, the IBM 305 could retain 15,000 items in a sales line at a district sales office and warehousing point. Also it would contain a to-date dollar volume, unit volume for each item, dollar and unit volumes for various groups of items, sales totals by branch sales offices and by salesmen, commission accounts, and customer invoice accounts.

Information is introduced to the unit by IBM punched card. Information from another office can be sent via a data transceiver and the resulting punched card introduced into the 305.

((See also BUSINESS WEEK, May 14, 1955; page 66-- and JOURNAL OF MACHINE ACCOUNTING, June 1955; pages 25, 26.))

JOURNAL OF THE ASSOCIATION FOR COMPUTING MACHINERY, April 1955 (Digital Computer Newsletter Supplement.)

The Univac (Remington Rand) high speed printer can be set to print 200, 400, or 600 lines a minute. Information on the input tape to the high speed printer is grouped in blockettes (10-word items of 120 characters). The tapes can be produced by either the card-to-tape converter, the Unityper II, or by the Univac itself. Up to 7,500 blockettes can be put on one high speed printer tape.

"A self-checking high-speed printer,"

by Earl Masterson, Eckert-Mauchly Division, Remington Rand, and Abraham Pressman, Pressman Associates, Philadelphia.
PROCEEDINGS of the Eastern Joint Computer Conference, December 1955; pages 22-30.

This is a technical description of the Remington-Rand high speed printer.

JOURNAL OF THE ASSOCIATION FOR COMPUTING MACHINERY, April 1955 (Digital Computer Newsletter Supplement.)

The Mnemotron ("memory device"), a high-speed magnetic core memory manufactured by International Telemeter Corporation has been delivered to the Rand Corporation, Santa Monica, California. It has a capacity of 4096 forty-bit words. A complete memory cycle including a read and write operation, takes 15 microseconds.

Northrop is producing a new digital plotter capable of plotting multiple curves at speeds approximating 8 pts/sec with the symbol selecting being controlled from the plotter input device. Up to 400 points may be plotted along the ordinate. The paper moves past the plotting head on the abcissa. If desired, the grid may be automatically printed.

A magnetic transfer recording technique in which recording heads are not used has been developed by Librascope, Inc., Glendale, California, for transferring magnetized coded data from documents to magnetic tape. The method would be used in data systems in which the source document has prequalified coded information recorded on it.

"Electronic data processing machines"

INSTRUMENTS & AUTOMATION, May 1955; pages 782-793.

The article consists of detailed descriptions of IBM card punch and electronic computing equipment. For those who are unfamiliar with any kind of automatic and mechanical office data processing machines this article will be an excellent reference; limited, however, to IBM equipment.

"Electronic computers for the businessman"

ELECTRONICS, June 1955; pages 122-131.

The article is a survey of manufacturers, price, sales record, and characteristics of 38 modern computers; along with tables showing input-output equipment and storage devices.

Management Decision-making Techniques

"The assembly line balancing problem," *by M. E. Salveson, General Electric Company, Louisville, Ky.*
THE JOURNAL OF INDUSTRIAL ENGINEERING, May-June, 1955; pages 18-25.

This paper attacks the problem of assigning the tasks required to complete an assembly to various stations (and therefore operators) so that all of the tasks are completed and so that the following conditions are met:

"a) the selected combinations of tasks satisfy the technological precedence relationships between tasks ((some tasks must precede others)), b) the sum of task performance times assigned to every station is equal to or less than the cycle time ((time available to make each assembly)) and c) the sum of the idle times over all stations is minimum."

It is assumed that the demand is known and the corresponding production rate is known. Also it is assumed that the standard times for performing jobs are available and are treated as if they were exact.

The problem is then treated by developing a mathematical analog or model. Certain mathematical principles are used to simplify the problem. The resulting formulation may be solved by techniques similar to those used in linear programming. However, until much better computational facilities are more generally available it is not possible for most persons to handle problems which are "large." It is expedient therefore, to develop practical methods which will usually yield an optimal solution (that is, one which makes the total idle time a minimum). The article then gives several practical methods of solving the problem, which appear to be suitable for hand or machine-aided computation depending upon the size of the problem. An example of an assembly job of eight tasks resulting in four stations is given.

Two interesting non-mathematical problems are mentioned. With better line balancing, there is "no longer slack time available for 'touch-up' work...that should be done in fabrication."

"Finally, the engineers...have obtained balances with so little idle time that some difficulty has been encountered because of increased frequency of operator failure to meet the cycle time. The reason for this difficulty is, of course, that all production rates or standards are really distributive" (subject to random variations).

((Mathematical details of the method are presented.))

"Queuing Theory," *by Wm. T. Morris, Ohio State University.*
THE JOURNAL OF INDUSTRIAL ENGINEERING, May-June 1955; pages 26, 27.

Queuing theory has been used in the study of such physical processes as:

a. aircraft waiting to land
b. motor vehicle traffic
c. machine breakdowns
d. telephone traffic, etc.

These models generally describe the following characteristics of a process:

a. an input--"customers" are arriving
b. a queue discipline--for example customers may wait their turn on a first-come-first-serve basis
c. a service mechanism--customers are "served" and thus removed from the waiting line.

The mathematical processes which are reviewed in article allow one to determine:

a. the expected number of people waiting in line
b. the effects of changes in the method of service (e.g., in a tool room, changing the number of attendants)

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c. knowing the expected number of men in line and the statistical situation, it is possible to look for unusual changes (by control chart methods) which indicate a change in the quality of service, or the service being required by customers, (e.g., in a tool room--tool shortages, or improper usage of tools)
d. the mean time which "customer" must wait for service--relations between service time and waiting time can be studied.

((The article reviews the mathematical statistics of queuing theory.))

"Using a computer to run a business"
*BUSINESS WEEK, May 14, 1955; pages 68-75. **

Rayco, maker of auto seat covers, is using statistical analysis, multiple correlation formulas, and the IBM Computing Center to determine the best locations for the statistically derived number of new stores in its new San Francisco territory. Thirty-seven variables were chosen as significant enough to be used in a multiple correlation formula to produce a relationship of potential sales in the area to 1954 Rayco sales in 51 sample cities. The complex equations using the 37 variables were solved by the 701 in IBM's New York Computing Center. Now Rayco's real estate men can begin looking for the most desirable property in the six areas pin-pointed bythe calculations as the logical locations for the stores.

Rayco is using the technique to test old store sites and manager efficiency, and to find out where not to locate, as well.

* Special permission to reprint received from BUSINESS WEEK.

"Introduction to model building on account data,"
by Charles B. Allen, The American Brass Co., Waterbury, Conn. N.A.C.A. BULLETIN, June 1955; pages 1320-1333.

Any business organization is a group of related activities which can be expressed in a manner which will result in predictable patterns. By considered manipulation of the conditions, it is possible to see how a business organization will change with varying circumstances.

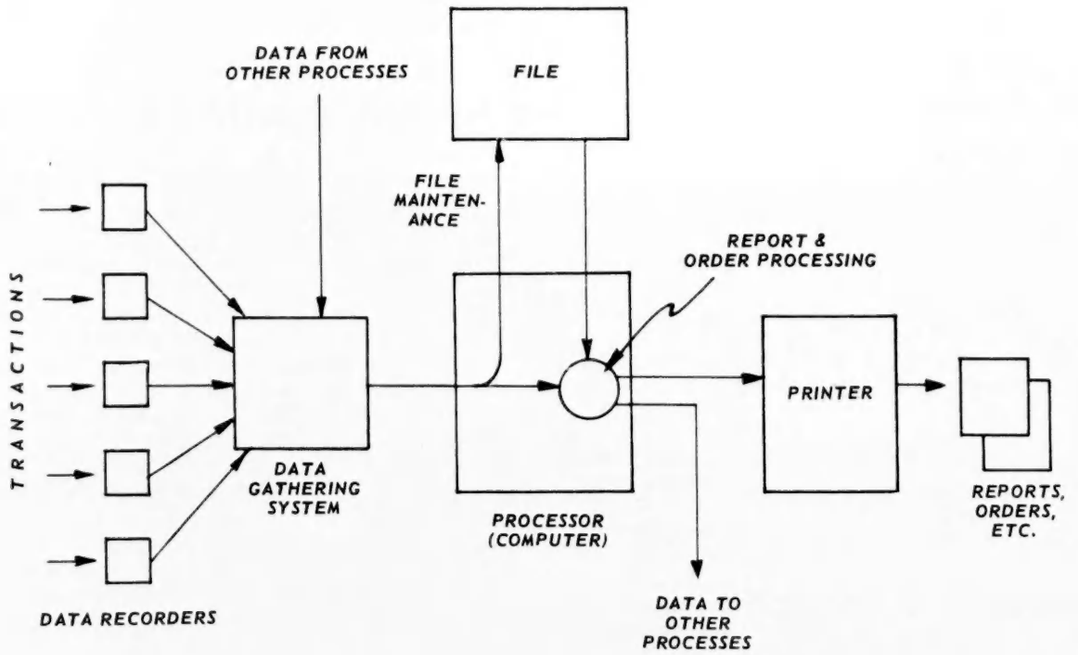
Model construction can be used in many areas to achieve this. For example: operational possibilities, cost and profit variation with volume, time and motion analysis, quality control, product mix for maximum profitability, interrelationship of price-cost-profit, marginal costs and revenue, derivation of economic lot sizes, where to produce and/or sell.

((The article includes a review of algebraic notation and some examples of the use of models to predict various results from an income statement.))

Business Data Processing—A Review

Part II - The Data Processing Pattern

In every business the problems of gathering and processing data differ. The sources of the data vary from the sale of an insurance policy to the movement of a job-lot in a factory. The processing required varies according to the volume and the requirements which the particular management has for reports and order-issuance. But in spite of these variations, there seems to be a basic pattern through which data flows in all business functions. This pattern is illustrated below:



This processing pattern occurs many times in each business; for sales records, for shop records, for cost records, for purchasing records, for payroll, and so on.

The raw materials for this processing are the records of transactions which take place throughout business. The data relative to every sale, every purchase, receipt, order, every manufacturing process (and even the processes involved in handling the data itself) which is significant to the profit position of the business, must be recorded. The data must then be gathered and brought to the processing unit.

The outputs of each process are the accounting and management reports required from the data handled in that system, and the routine orders which must be issued as a result of the processing, such as purchase orders, bank orders (checks) and internal orders like shop orders. Data also is transferred from one process to another in order to make available all information required.

A major problem in designing a business system is determining which files must be established, and what data must be maintained in the files. Then one must determine what data must enter each process in order 1) to maintain the files up-to-date and 2) to provide the necessary outputs. The arrangement of the system is affected by the requirements of management

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and by the equipment available to do the job. The advent of electronic filing and processing systems has allowed the consolidation of information into fewer files, which results in more efficient processing, since reference to a file is a costly process. [1]

Unfortunately, there are no good rules-of-thumb for designing file and processing systems. In each company a careful study must be made by qualified personnel who can look at the company-wide data processing problems. They must investigate requirements set up by accounting practice, management policy and the nature of the business. Then they must examine equipment available to meet these requirements and match the two in the most economical manner. The design of business data processing systems is an engineering job more complicated than the design of many physical systems, because of the number of factors involved and the variability of the components.

(Next month we will discuss data processing systems further.)

1. Regarding consolidation of files in insurance, see: "New Recording Means and Computing Devices," Society of Actuaries, 1952; 208 S. La Salle Street, Chicago 4, Ill.

Training, Seminars, Meetings

The Rich Electronic Computer Center has been established at Georgia Institute of Technology, Atlanta, Georgia, as a division of the Engineering Experiment Station. The Computing Center is equipped with an ERA 1101 computer and a CRC 102D. Activities will include research on computer components, computational services, and training of mathematicians and engineers in all phases of digital computation. Machine time is available for sponsors. Dr. E. K. Ritter is Director. ((From Journal of Association for Computing Machinery, April 1955; Digital Computer Newsletter Supplement.))

University of Michigan course on computers--Aug. 1 through 12, 1955. Cost: $160.00 plus lodging. Write to: Dr. John W. Carr, Willow Run Research Center, University of Michigan, Ypsilanti, Michigan.

Operations Research Society of America national meeting, Aug. 15-17, Hotel Statler, Los Angeles. Program Chairman: Robert A. Bailey, Lockheed Aircraft Corp., Burbank, Calif.

"Electronics and Automatic Production," symposium sponsored by National Industrial Conference and Stanford Research Institute, Aug. 22, 23, San Francisco.

Case Institute of Technology Short Course, Sept. 6-16, 1955. "Operations Research in Production and Inventory Control." Write to: Dr. E. Leonard Arnoff, Short Course Director, Case Institute of Technology, Cleveland, Ohio.

Instrument Society Computer Clinic, Sept. 14-16, Los Angeles.

Association for Computing Machinery, Sept. 14-16, University of Pennsylvania.

Controllers Institute, Nov. 7-9, Statler Hotel, Los Angeles.

National Machine Accountants Association Electronics Business Systems Conference, Nov. 10, 11, Statler Hotel, Los Angeles.

Comment

Two terms--"redundancy check" and "compiler" have occurred in recent literature and perhaps deserve an attempt at definition.

There are two general methods of checking the accuracy of data being processed. One is to check its "reasonableness" against pre-stored criteria. For example, in a shop, the quantity of items being processed at one operation plus any scrap and uncompleted work should equal the quantity satisfactorily completed at the previous step. Another example would be to check that the sales reports from branches do not exceed or go below certain reasonable limits. Such checks can be very effective, but must be programmed for each application.

The second method of checking is by introducing "redundancy" into the data in a prescribed way. Duplicating information is one redundancy method, although somewhat expensive. More sophisticated techniques are available where extra digits are added to pre-assigned key numbers such as employee number, shop order number, sales order number.[1] The extra digits are obtained from the basic number by a short computation which can be repeated and checked whenever the number is re-recorded. If the recalculated extra digits are different from those transmitted, an error is indicated. The "parity" check is a redundancy method of checking binary-coded decimal data. Redundancy checks can be devised to check most common types of errors. They are especially useful in checking the copying and transmission of data, and can be used, but with some difficulty, in checking computations. They cannot check the initial entry of variable data such as quantities or prices. Reasonableness checks and normal accounting procedures must be used here.

A "compiler" is a computer program used to write other working programs. Compilers allow the programmer to code in a language with which he is familiar, for example, mathematical symbols when programming scientific problems. The compiler will convert this program (usually quite short) into the required lengthy program in machine language.

In the business field the use of compilers is just starting. They have been written to allow the preparation of sorting programs, where the user indicates merely the number and structure of the items to be sorted, and the location of the key on which to sort. Another has been written to develop programs to feed data into and out of a computer according to the requirements of the user.[2]

In business applications the most useful compilers will allow the user to describe the problem essentially in his native language (numbers, English, and perhaps simple symbols) and the result is the required program in machine language. Good compilers can significantly reduce the number of man-hours required to establish programs for a computer in a particular application.

1. Richards, "Arithmetic Operations in Digital Computers," Van Nostrand, 1955; pages 187-190, 220-225.

2. BIOR Compiling System, Remington Rand, Inc.

References

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